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Montana Department of Transportation

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STAGE I RESEARCH PROBLEM STATEMENT

I. PROBLEM TITLE:

Synthesis of Warm Mix Asphalt (WMA) Paving Strategies for Use in Montana Highway Construction

II. PROBLEM STATEMENT:

Use of Warm Mix Asphalt (WMA) as an alternative to conventional Hot Mix Asphalt (HMA) is gaining national momentum. WMA uses recent technological advances that reduce the temperature needed to produce and compact asphalt for use on roadways. It offers the potential to 1) reduce construction costs by lowering energy use, 2) improve quality and efficiency of construction, and 3) improve environmental stewardship through decreased air emissions. These benefits make WMA technologies appealing to highway agencies and the asphalt paving industry given increased energy costs, reduced highway construction and maintenance budgets, and tighter environmental regulations.

WMA is produced at temperatures that are 30° to 100ºF lower than typical HMA. Due to the lower required temperature, one primary benefit of WMA is a significant reduction in fuel consumption when compared to the energy needed to produce traditional HMA. WMA production lowers the viscosity of the asphalt binder, which slows cooling rates and reduces aging. This results in better compaction, the ability to haul the mix for longer distances, and improved pavement durability. Because the cooling time of WMA is extended, paving and patching at cooler temperatures may be more successful during the early and late construction seasons in Montana. Furthermore, emissions are reduced both at the batch plants and around the paving sites due to the lower temperature at which the mixes are produced.

Despite these promising benefits, numerous experimental studies and construction projects using WMA have demonstrated varying levels of performance. Several problems have been identified in California related to increased and premature rutting of surface asphalt concrete courses, while other studies have found moisture damage to be an increasing concern when WMA is used. Moreover, different WMA technologies have been reported to lead to various types of pavement distresses. Although there are considerable benefits such as reduced thermal cracking, reduced fatigue cracking, and prevention of tender mixes due to minimized oxidative hardening of binder at lower operating temperatures, the overall trade-off of using WMA in Montana conditions is not yet clear. Within this context, research is needed to investigate how to implement WMA practices into Montana highway construction.

III. RESEARCH PROPOSED:

There are two main phases necessary to implement WMA paving practices in Montana. The first is a synthesis of available information related to WMA research, implementation and performance. The second is a field test to monitor and verify field performance under Montana conditions. The research outlined herein proposes to complete work associated with the first phase—namely, to synthesize nationwide performance, cost-effectiveness and implementation strategies of various WMA technologies to evaluate their suitability as an alternative paving technology in Montana. To accomplish this, a comprehensive literature review and a nationwide survey will be conducted with an emphasis on states having climates similar to Montana. Relevant information will be collected and synthesized, including:

- types of WMA technologies and materials, and their mix-design procedures;

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- mechanistic and chemical properties of common WMA-modified asphalt binders;
- Montana's primary aggregate types and their potential performance in WMA;
- suitability of WMA technologies to incorporate recycled asphalt pavement (RAP) at various percentages;
- WMA paving operations in overlays, interim surfacing, and leveling courses;
- potential improvements in crack resistance, durability, rutting, moisture susceptibility and structural integrity of WMA; and
- emissions and fuel energy consumption during WMA production and paving operations.

IV. IT COMPONENT:

The work proposed herein does not require IT hardware, software or support.

V. URGENCY AND EXPECTED BENEFITS:

More than 90 percent of the 24,000 lane-miles of paved roads throughout Montana use asphalt concrete, and the actual service life of asphalt surface courses is typically shorter than 20 years. Millions of dollars could be saved by extending the life of these pavements and by reducing new construction costs. An estimate of the total savings includes 10 to 30 percent directly related to mixture production and pavement construction, and at least 10 percent savings on pavement preservation from improved durability of asphalt mixes. Decreased fuel use and maintenance frequency would benefit Montana Department of Transportation (MDT) through reduced costs on asphalt paving projects.

VI. IMPLEMENTATION PLAN:

Based on the literature synthesis, a cost-effectiveness analysis of WMA use will be conducted relative to the constructability, performance, environmental and traffic effects and other considerations as compared to traditional HMA. Recommendations will then be made to MDT to implement WMA as an alternative to HMA in Montana. In addition, evaluation and acceptance procedures relative to WMA technologies will be summarized. All the information collected during this research project will be documented in a final report for MDT, and an executive presentation will be made to the MDT Research Advisory Panel at the conclusion of the project. If it becomes apparent from the results of this project that WMA is a viable and cost-effective alternative to traditional flexible pavement construction, then a field test trial to monitor constructability and field performance will be discussed at that time.

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Note: Submitter may attach continuation sheets if necessary.